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v. 20
p 41-66

No. 7

ZOOLOGICAL SERIES
OF
FIELD MUSEUM OF NATURAL HISTORY

Volume XX

CHICAGO, DECEMBER 11, 1933

Pages 41-66

NOTES ON FISHES OF THE FAMILY
HEMIRHAMPHIDAE

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In attempting to locate properly a remarkable genus, *Odontorhamphus* gen. nov., of the family Hemirhamphidae, collected by the Philip M. Chancellor-Field Museum Expedition to Aitutaki Island, Cook Archipelago, central Pacific, it has been necessary to examine critically all the available generic descriptions in the family. These descriptions show such grave discrepancies and omissions that it has seemed advisable to bring together all the information in such form that it may be available as a basis for future work. The entire group is urgently in need of a revision based on a series including at least a majority of the nominal species. Such a revision will probably require reexamination of most of the specimens now in museums.

The great need for a revision of this group may be illustrated by some examples taken from the collections of Field Museum. There are four groups of specimens that were identified as *Hyporhamphus roberti*. First, a group from the Atlantic end of the Panama Canal, since named *Hyporhamphus hildebrandi*, is very slender, with the ventral fins almost midway between the hypural joint and the gill opening and with the beak considerably longer than the rest of the head. A group from Mazatlan, Mexico, is somewhat stouter, with the ventrals much nearer the gill opening than the hypural joint and with the beak as long as the rest of the head. Those of a group from Trinidad are slender, with the ventrals almost midway between the hypural joint and the gill opening and with the beak just longer than the rest of the head. Those of a fourth group were collected in Bermuda, by T. H. Bean. They are much stouter, with the ventrals much nearer the hypural joint than the gill opening and with the beak much longer than the rest of the head. Therefore it appears that four distinct species are labeled *Hyporhamphus roberti*.

Four groups labeled *Hemirhamphus brasiliensis*, from Key West, Bermuda, Jamaica, and the Atlantic end of the Panama Canal, differ slightly in the relative length of the beak, in the position of the ventrals and in stoutness of the body. Some of these local variations might possibly be proved to be specific by combination with other characters.

Groups of specimens labeled *Hyporhamphus unifasciatus* from many localities in the Atlantic and Pacific oceans show a much greater general uniformity of characters. In each ocean they show several local groups but the general average is quite uniform, except that the specimens from the Pacific seem to have somewhat longer beaks. It seems likely that several local races might be determined from either the Atlantic or the Pacific and that the groups from the two oceans might be proved to be distinct species.

The family Hemirhamphidae, as at present understood, is readily divisible into two major sections. In one section, containing only a single genus and species, *Chriodorus atherinoides* Goode and Bean, the lower jaw is not at all prolonged, not extending as far forward as the tip of the upper. The teeth are also much larger than in other members of the family and are arranged in two distinct rows instead of in more or less broad bands. The remaining genera and species resemble each other in having at least some indication of a prolongation of the lower jaw and in having the teeth irregularly arranged in bands in the jaws.

Hemirhamphidae, other than *Chriodorus*, may be readily divided into two groups that show a surprising similarity of parallel development. In each group there is at least one genus with practically no beak. There are genera with beaks of varying lengths and with various degrees of elongation of the body and, in each group, there is a genus with bands of teeth extending to a considerable distance from the rim of the mouth, along the upper surface of the beak.

A group of these fishes, which we may call the river halfbeaks, has the caudal fin rounded, truncate, or sigmoid with an upper or lower point, never deeply forked; the dorsal and anal fins rounded, never with a concave distal margin; the anal fin of the male usually modified; and the nasal barbels rather long, tapering, and not concealed in the nasal fossa. Fishes of this group are frequently (perhaps usually) viviparous. They are found in fresh waters of the East Indian and central Pacific regions, where they sometimes enter brackish estuaries and, perhaps, go down into the sea.

In the other group of halfbeaks the tail is forked, usually very deeply, with the lower lobe generally much larger than the upper; the distal margin of dorsal and anal fins usually more or less concave, often falcate; the anal fin of the male never modified and the species probably never viviparous; the nasal barbels short, expanded at tip and usually more or less concealed in a nasal fossa. These fishes are inhabitants mainly of shore waters in all warm seas. A few of them are pelagic, some enter rivers and a very few are permanent residents of fresh-water lakes.

Both of these groups have been divided into genera and subgenera, often on trivial characters and all too often without any direct indication of the structural differences on which the separation is based. In an endeavor to furnish a valid basis for an understanding of the group I have selected twelve groups of characters that have been used in some or all of the descriptions and have tried to fit the published diagnoses into the list. These characters, arranged somewhat in the order of their taxonomic value, are: (1) nasal barbel; (2) anal fin modified or not; (3) form of caudal fin; (4) length of beak; (5) airbladder simple or cellular; (6) position of ventrals; (7) form of body; (8) length and position of pectoral fins; (9) position and form of dorsal fin; (10) form and arrangement of the teeth; (11) form of the premaxillary plate (properly called maxillary-premaxillary plate as it is formed by the fusion of both elements); (12) size of the scales. Each of these characters, alone or in connection with others, has been used in defining some group of Hemirhamphidae but there are very few generic diagnoses in which even a majority of them are mentioned.

Two nominal genera have been included in the family because of the prolonged lower jaw. These are *Oxyporhamphus* Gill and *Hemioxocoetus* Fowler. Gill's name was based on *Hemirhamphus cuspidatus* Cuvier and Valenciennes (1846), a name given to two small (4 inches long) specimens taken by Dussumier from the stomach of a bonito in the Indian Ocean. The published figure of this fish (Cuvier and Valenciennes, 19, pl. 557, 1846) strongly resembles various pictures of *Evolantia microptera* (Cuvier and Valenciennes) but the fin count, D. 18, A. 12, is quite different. Weber and De Beaufort (1922) give the fin counts of the latter species as D. 13-16, A. 14-16. It is possible, although hardly probable, that *cuspidatus* represents an extreme variation of *microptera*, but it does seem likely that both belong to the same genus, in which case Gill's name, *Oxyporhamphus*, would have precedence

over *Evolantia*. On the other hand, *Oxyporhamphus* may be the young of some species of *Parexocoetus*. In the absence of specimens, this question must remain theoretical. This much is sure, with the information at hand, there is about as much reason for including *Oxyporhamphus* in the Exocoetidae as in the Hemirhamphidae.

The genus *Hemioxocoetus* was based by Fowler on a small specimen with a very long beak. This has since been shown by Nichols and Breder (1928) and accepted by Fowler (1929) to be a young individual of a species of *Fodiator* Jordan and Meek.

DEFINITIONS

In order to avoid confusion and wrong interpretations it is necessary to give some definition and discussion of certain terms.

Nostrils and nasal barbels.—The nostrils are openings in a membrane that is stretched over a rather large nasal fossa on each side of the head a short distance in front of the eye. In some forms (or in some states of preservation?) this membrane is stretched level with the surface of the head, while in others it is more or less depressed into the nasal fossa, in some cases apparently along its bottom. The nasal barbel arises as a fleshy structure about the center of this membrane. In the river halfbeaks the barbel is approximately as long as the pupil, tapering, and extending well above the surface of the head ("Ein Nasalbärtel jederseits," Mohr, 1926, p. 240). In the genera of the marine group, the barbel is shorter and thickened at the tip, being mushroom-shaped, leaf-shaped, spatulate or club-shaped, its basal membrane usually well toward the bottom of the nasal fossa and the barbel not extending much above the surface of the head ("Keine Nasalbärtel," Mohr, 1926, p. 240). The reason for considering this structure a barbel in one case and not in the other does not seem quite clear. It seems to be the same type of structure in either case and stands near the center of the nasal fossa, directly behind the opening of the nostril.

Anal fin modified.—Many (perhaps most or all?) of the river halfbeaks have certain rays of the anal fin more or less enlarged and variously modified in adult males. The change may be anything from a slight lengthening to a very complex structure. In some species of *Zenarchopterus* one (or more) of the rays is enormously thickened, greatly elongated and provided with secondary rays that make it look like a portion of the shaft and vane of a feather.

Beak.—The beak, as here used, is that part of the lower jaw in front of the tip of the premaxillary plate. It is to be measured from

the forward end of the depression that forms the mouth, just inside the band of teeth on the rim of the mouth.

Airbladder.—The structure of the airbladder is somewhat difficult to observe as the walls are thin and the cells sometimes quite large.

Premaxillary plate.—The “premaxillary” or “intermaxillary” plate should, properly, be called the maxillary-premaxillary plate as it is formed by the nearly complete fusion of those elements. In form it is more or less triangular, with a wing projecting from each lateral corner. The triangular portion lies on top of the head, forming the roof of the mouth, while the wings bend down on the sides of the head and are attached to the lower jaw in such a manner that depressing the lower jaw raises the plate like a door. The shape and proportions of this plate are used constantly in generic and specific diagnoses in this family but, so far as I know, no one has described just how they are applied. When the mouth is open this plate is tilted upward and there is a fairly definite joint between it and the top of the head that forms one logical starting point for a measurement. The tip of the plate forms another definite place for measuring and the length is easily obtained. Judging from measurements given in the literature, various authors have used different ways of determining the width of this structure. If we measure its entire length, it would seem logical to measure, also, its entire width, across the wings, a measurement comparatively easy to make with dividers. Apparently, many authors have tried to measure the width just in front of the wings. This would also be easy to do if there were a definite angle between the wing and the edge of the flat portion of the plate. In very many cases the two come together on a very gentle curve and it is not possible for one person to tell just what point another may have considered the junction. The result has been very serious discrepancies between descriptions of the same fish by different authors. In original descriptions in this paper, the measurement across the wings has been used. The parts that have been compiled from the literature retain the authors’ statements and some differences will be found.

Scales.—The size of the scales in this group is not easy to express and yet it has a definite relationship to the various sections. *Euleptorhamphus* has rather large scales, yet, owing to its very long body, there are about a hundred or more in a lateral series. In *Eulepidorhamphus*, which has a body about as elongate as is usual in the marine halfbeaks, the scales may be considered to be very small with a count of 90 to 100 or more. They are also small in

Nomorhamphus, which has from 50 to 60 scales in a lateral series. The scales in the entire group are often closely and irregularly imbricated, which makes it difficult to count them exactly, especially when many of them have been lost, as is often the case.

Form of body.—There are three rather distinct types of form of body in this group. The river halfbeaks seem to have a tendency for the body to be somewhat wedge-shaped in cross section, with a broad back and the straight sides slanting toward a narrow belly. The body is usually comparatively short. The marine forms, except *Euleptorhamphus*, have the body more elongate, with a distinct tendency for an approach to a rectangular cross section. The back is fairly broad, with a tendency to be flattish or gently rounded, the sides are often noticeably flattened, and the belly is broad and quite flat, with its edges defined by the lateral line; that is, defined by a ridge of scales that are much less deciduous than those on the rest of the side. *Euleptorhamphus* has the body very long, narrow and flat-sided, so it is properly described as band-like.

KEY TO GENERA OF HEMIRHAMPHIDAE

This key and the generic descriptions following have been compiled mostly from the literature. They are submitted in the hope that they may help in bringing some order out of this chaotic group. Because of the manner in which the key is prepared there will be found many errors and discrepancies that cannot be corrected without an amount of work for which the present author has neither the time nor the material. No attempt has been made to distinguish between genera and subgenera.

1. Lower jaw not elongated, not extending as far forward as tip of snout.

Chriodorus

Lower jaw more or less elongated, extending at least as far forward as tip of snout. 2

2. Nasal barbel evident, extending above surface of head, about as long as pupil, not concealed in nasal fossa, tapering; caudal fin usually convex; anal fin of males usually modified; mostly fresh-water species. 3

Nasal barbel more or less concealed in nasal fossa, shorter than pupil, expanded at tip; caudal fin more or less deeply forked, when deeply forked with lower lobe much longer than upper; anal fin of males not modified; mostly marine species. 8

3. Band of teeth of lower jaw extending some distance forward beyond tip of premaxillary plate. *Hemirhamphodon*

Band of teeth of lower jaw not extending on beak beyond rim of mouth 4

4. Beak very short, barely extending beyond premaxillary plate. . . *Nomorhamphus*

Beak longer, at least half as long as rest of head. 5

5. Beak usually shorter than rest of head; dorsal shorter than anal, inserted behind anal; ventrals inserted about midway between gill opening and hypural joint; scales moderate. 6

- Beak usually longer than rest of head; dorsal longer than anal, inserted before anal; ventrals inserted nearer hypural joint than gill opening; scales large..... 7
6. Premaxillary plate longer than broad..... *Dermogenys*
Premaxillary plate much longer than broad..... *Rhamphodermodenys*
7. Premaxillary plate varying from broader than long to longer than broad.
..... *Zenarchopterus*
Premaxillary plate twice as long as broad..... *Labidorhamphus*
8. Teeth of lower jaw extending on beak some distance beyond tip of premaxillary plate..... *Odontorhamphus* gen. nov.
Teeth of lower jaw not extending on beak beyond rim of mouth..... 9
9. Beak very short, barely extending beyond premaxillary plate.... *Arrhamphus*
Beak longer, at least half as long as rest of head..... 10
10. Body very long, strongly compressed, bandlike, back subcarinate; pectoral fins very long; scales moderate..... *Euleptorhamphus*
Body not extremely elongate, more or less compressed, not bandlike, back more or less rounded or flattened; pectoral fins moderate, usually about two-thirds as long as head without beak; scales various..... 11
11. Body much deeper than wide..... *Farhians*
Body not extremely compressed, its width usually about two-thirds of the depth..... 12
12. Dorsal inserted in advance of anal, its base longer than that of anal; ventral nearly as long as pectoral, the inner ray produced..... *Ardeapiscis*
Dorsal insertion nearly over that of anal, its base about as long as that of anal; ventral about half as long as pectoral, the inner ray not produced.. 13
13. Ventral insertion nearer hypural joint than gill opening; airbladder cellular; teeth simple..... 14
Ventral insertion about midway between hypural joint and gill opening, frequently nearer gill opening; airbladder simple; teeth tricuspid..... 15
14. Beak not much longer than rest of head..... *Hemirhamphus*
Beak much longer than rest of head..... *Rhynchorhamphus*
15. Scales moderate to large..... *Hyporhamphus*
Scales small..... *Eulepidorhamphus*

The group to which Whitley (1931) gave the name *Reporhamphus* is not included in the above key because the four species referred to it, as described in the literature, exhibit a bewildering array of contradictory characters. The type of the genus is *Hemirhamphus australis* Günther, a marine form with rather deeply forked caudal, ventrals inserted nearer hypural joint than gill opening, falcate dorsal fin, tricuspid teeth and airbladder not described. The other three are river forms with slightly forked tail, ventrals inserted nearer gill opening than hypural joint (in *ardelio* and *regularis*) or nearer hypural joint than gill opening (in *melanochir*), dorsal not falcate, tricuspid teeth (in *melanochir*, not described in the other three), and airbladder simple (in *melanochir*, not described in the other three). This genus, then, comprises two species that, on the basis of generally accepted descriptions, should be placed in

Hemirhamphus and two that, on a similar basis, should be in *Hyporhamphus*. Whitley, himself, published no description of his genus, simply designating a genotype and indicating the species that he considered should be included in the group. In the absence of specimens of any members of the group and in consideration of the very meager descriptions that have been published, it is impossible to find any grounds for combining these four species, except that they all occur in Australian waters (see p. 59).

DESCRIPTIONS

Chriodorus Goode and Bean (1882).

Type *Chriodorus atherinoides* Goode and Bean 1882.

(1) Nasal barbel leaf-shaped, nearly concealed in nasal fossa, distal portion almost reniform in outline (specimens). (2) Anal fin not modified in males. (3) Caudal fin forked, lower lobe larger than upper. (4) No beak, lower jaw shorter than upper. (5) Airbladder cellular (specimen). (6) Ventrals inserted nearer gill opening than hypural joint, small (specimens). (7) Body elongate, moderately compressed, back rather narrow, rounded (specimens). (8) Pectoral moderate, inserted high on side (specimens). (9) Dorsal fin about opposite anal and about equal to it in length, last rays not produced, distal margin concave (specimens). (10) Teeth in two rows in each jaw, large for the family, tricuspid. (11) Pre-maxillary plate very short. (12) Scales large.

Hemirhamphodon Bleeker (1866).

Type *Hemirhamphus phaiosoma* Bleeker 1852.

(1) Nasal barbel tapering, not expanded at tip, not concealed in nasal fossa. (2) Anal fin modified in male. (3) Caudal fin rounded or acuminate. (4) Beak about as long as rest of head. (5) Airbladder not described. (6) Ventrals inserted about midway between gill opening and hypural joint, longer or shorter than pectorals. (7) Body elongate, compressed, back rounded. (8) Pectorals rather small, inserted low on side. (9) Dorsal fin inserted before or behind ventrals, much longer than anal, distal margin rounded. (10) Teeth conical, in bands in both jaws, a band of teeth on each side of upper surface of beak, represented in the figure of Weber and De Beaufort (1922) as in three rows in each band and extending to the tip of the bone. (11) Premaxillary plate longer than broad. (12) Scales small, various in size and arrangement, enlarged on nape, much enlarged in parietal region.

Nomorhamphus Weber and De Beaufort (1922).

Type *Nomorhamphus celebensis* Weber and De Beaufort 1922.

(1) Nasal barbel tapering, not concealed in nasal fossa. (2) Anal fin subtruncate, not otherwise described, perhaps modified in male. (3) Caudal fin subtruncate, slightly rounded. (4) Beak barely extending beyond premaxillary plate. (5) Airbladder not described. (6) Ventrals nearer to gill opening than to hypural joint, moderate. (7) Body rather short for the group, compressed, back probably rounded, fairly broad. (8) Pectoral moderate, inserted high on side. (9) Dorsal inserted behind anal origin, shorter than anal, its distal margin convex. (10) Teeth simple, in bands in both jaws. (11) Premaxillary plate as long as or longer than broad. (12) Scales moderate to small.

Dermogenys van Hasselt (1823).

Type *Dermogenys pusillus* van Hasselt 1823.

(1) Nasal barbel tapering, not concealed in nasal fossa. (2) Anal fin not modified in male (Weber and De Beaufort, 1922), distal margin convex. (3) Caudal fin rounded. (4) Beak usually shorter than rest of head. (5) Airbladder not described. (6) Ventral fins inserted about midway between gill opening and hypural joint, or a little nearer to either. (7) Body moderately elongate, somewhat compressed, back not described, probably somewhat flattened. (8) Pectorals moderate, inserted high on side. (9) Dorsal fin inserted behind anal, its base shorter than anal base, last ray not produced, distal margin convex. (10) Teeth simple, in bands in both jaws, none on beak beyond rim of mouth. (11) Premaxillary plate longer than broad. (12) Scales moderate.

I am indebted to Dr. C. L. Hubbs for the following quotation from *Algemeene Konst- en Letter-bode* (Haarlem), 2, 1823, giving the original description of the genus *Dermogenys* van Hasselt: "Een *Hemirhamphus*, welke in de beken rondom Buitenzorg en bijna overal op Java gevonden wordt, is reeds gedurende het leven van Kuhl, van dit geslacht, door ons afgescheiden onder den naam *Dermogenys*, en wel om de membraneuse uitbreitling, die zich aan iedere zijde de beide maxillen bevindt; de species draagt den naam van *Pusillus*, wordt door de Javanen joelong—joelong genoemd en is door ons afgebeeld geworden."

The description above is contained in a portion of a letter from van Hasselt to C. J. Temminck. Apparently the same portion of the letter was translated to French and printed the next year in the

"Bulletin des sciences naturelles." It is not clear from this paragraph or from the translation whether Kuhl and van Hasselt actually published the genus and species above described or only prepared it for publication.

Rhamphodermogenys Fowler and Bean (1922).

Type *Dermogenys* (*Rhamphodermogenys*) *bakeri* Fowler and Bean 1922.

(1) Nasal barbel not described, probably not different from *Dermogenys*. (2) Anal fin not described. The figure suggests that it is considerably modified in the male. (3) Distal margin of caudal fin sigmoid, with a small point at top. (4) Beak shorter than rest of head. (5) Airbladder not described. (6) Ventral fins inserted nearer to gill opening than to hypural joint, small. (7) Body moderately elongate, back broad, sides flattened and converging toward the narrow belly. (8) Pectoral moderate, inserted high on side. (9) Dorsal fin inserted behind front of anal, its base shorter than anal base, distal margin convex. (10) Teeth conical, in bands in each jaw, none on beak in front of rim of mouth. (11) Premaxillary much longer than broad. (12) Scales large.

Described as a subgenus of *Dermogenys*, based on the great length of the premaxillary plate and the forward position of the ventral fins. If the form of the anal fin as shown by Fowler and Bean is a sexual character and there are no intergradations with the condition mentioned for *Dermogenys* by Weber and De Beaufort (1922, p. 137), this form probably should stand as a distinct genus.

Zenarchopterus Gill (1863).

Type *Hemirhamphus dispar* Cuvier and Valenciennes 1846.

(1) Nasal barbel tapering, not concealed in nasal fossa. (2) Anal fin modified in the male. (3) Caudal fin variously rounded, sometimes with a secondary point below. (4) Beak various, frequently longer than the rest of the head. (5) Airbladder simple (Cuvier and Valenciennes). (6) Ventrals inserted nearer to the hypural joint than to the gill opening, small. (7) Body elongate, more or less compressed, back flattened. (8) Pectorals moderate, inserted high on side. (9) Dorsal inserted before anal, longer than anal, the distal margin convex, often with some of the rays produced in the males. (10) Teeth conical, those of the mandible confined to the rim of the mouth. (11) Premaxillary plate varying from broader than long to longer than broad. (12) Scales large.

Labidorhamphus Fowler (1905).

Type *Hemirhamphus amblyurus* Bleeker 1849.

(1) Nasal barbel tapering, not concealed in nasal fossa. (2) Anal fin modified in males. (3) Distal margin of caudal fin somewhat sigmoid, not forked, lower point not produced. (4) Beak much longer than rest of head. (5) Airbladder not described. (6) Ventrals inserted much nearer to hypural joint than to gill opening. (7) Body elongate, somewhat compressed, back rounded. (8) Pectoral moderate, inserted high on side. (9) Dorsal fin inserted in front of anal, base longer than that of anal, distal margin somewhat sigmoid in outline, the last rays not produced. (10) Teeth conical, the mandibular band on rim of mouth. (11) Premaxillary plate twice as long as broad. (12) Scales large.

Described as a subgenus of *Zenarchopterus*, apparently on the basis of the single character of the very long premaxillary plate.

Odontorhamphus gen. nov.

Type *Odontorhamphus cancellori* sp. nov.

(1) Nasal barbel very broadly spatulate, the expanded portion irregularly subtriangular, reflexed, nearly covering the nasal fossa but not rising appreciably above it. (2) Anal fin not modified in the male. (3) Caudal fin moderately forked, the lower lobe much longer and wider than the upper. (4) Beak as long as rest of head. (5) Airbladder cellular. (6) Ventrals inserted nearer to hypural joint than to gill opening, the fin about half as long as pectoral. (7) Body elongate, compressed, the sides and belly flat, the back gently rounded. (8) Pectoral moderate, inserted high on side. (9) Dorsal fin inserted very slightly in advance of anal; its base about as long as that of anal; the distal margin concave, the first rays somewhat elevated, not falcate, the last ray somewhat produced. (10) Teeth simple, in bands on premaxillary plate and on upper surface of beak nearly to tip. The band of teeth on premaxillary plate extends down on the lateral wings about to the level of the mandible, with a few scattered teeth on the edge of the plate below the band on one side. On the lateral wings the band of teeth at its lower end occupies a considerable area on the outside of the plate. Careful dissection would be needed in order to show whether these teeth are on maxillary or premaxillary. There is a band of teeth on each side of mandible from near the tip of beak to just inside the corner of the mouth. These bands are widened so that they cover the entire upper surface of the mandible from the rim of the mouth outward. They nearly

meet in front of the mouth. Just in front of the mouth each band is narrowed abruptly and continues forward along each side of the beak, leaving a narrow toothless space the entire length of the center of the upper surface. There are no teeth on the sides or the lower surface of the beak. The teeth are conical, with a varying degree of slight curvature, variously pointed; some taper evenly from base to tip, while others are abruptly pointed at the tip, suggesting the possibility of descent from, or variation toward, a tricuspid condition. (11) Premaxillary plate (measured from top of head, with the mouth open) as long as the width across the lateral wings, including the lateral bands of teeth. (12) Scales moderate, closely imbricated forward.

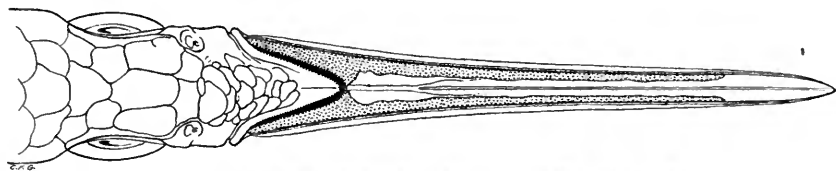


FIG. 1. *Odontorhamphus chancellori* sp. nov. Dorsal view of head.

***Odontorhamphus chancellori* sp. nov.**

Type from Aitutaki Island, Cook Archipelago, Pacific Ocean. No. 16,208 Field Museum of Natural History. Length, total 240 mm. (from tip of premaxillary plate to hypural joint 170 mm.). Collected, 1930, by Philip M. Chancellor.

D. 15; A. 17; P. 11; V. 6; scales about 83, 5 of them beyond the hypural joint, rather large but closely imbricated, somewhat deciduous and very difficult to count. Gill rakers 27–29 on the lower arm of the first arch, 9–7 on the upper, total 36, the longest about half as long as pupil. No clear division between the upper and lower arms of the gill arch. Branchiostegals 12. Beak .23,¹ barely longer than rest of head. Head from tip of premaxillary plate .22. Entire head .45 (.32 of total length). Eye .06 (3.7 in head). Length of premaxillary plate .053 (4.2 in head), its width .047 (4.7 in head). Interorbital width .05 (4.4 in head), flat or barely concave, its general surface slightly below upper edge of orbital rim. Depth .11 (2 in head). Width of body .08 (2.8 in head, 1.4 in depth). Pectoral .14 (1.6 in head). Ventral .08 (2.8 in head, 1.8 in pectoral). Distance from ventral base to hypural joint .35, to gill opening .44. Dorsal origin about one ray ahead of anal, both fins scaled at base in front,

¹These linear measurements are given as decimals of the standard length, tip of upper jaw to hypural joint.

the scales disappearing at about eighth dorsal and ninth anal rays, forming a sheath in front. Distal margins of both dorsal and anal fins concave, the first rays moderately elevated, not falcate, the last rays slightly produced. Caudal fin moderately forked, the lower lobe much longer and wider than the upper; the shape of the fin about as in T. C. Roughley's (1916, pl. 4) plate of "*Hemirhamphus intermedius*."

The back is broad and rather flat. The lateral line does not seem to form so well marked a ridge as in some other species, although it marks the separation between the flat belly and the rather flat side. In cross section the body would be rather notably subrectangular in outline.

The premaxillary plate, measured from the top of the head to the sharply pointed tip, with the mouth open, is slightly longer than the width across the wings. The teeth are in broad bands, so close to the edge of the plate that the outer row shows from above. The lateral bands of teeth do not quite meet in front, leaving a triangular space that is filled by a patch of smaller teeth. A slight groove separates this central patch of teeth from the lateral bands. On the lateral wings of the premaxillary plate the bands cross over the edge to the outer surface, forming, on each side, a comparatively broad patch that is just above the level of the upper surface of the mandible when the mouth is fully open. In the type specimen the lateral wings of the premaxillary plate are not quite symmetrical. On the left side, the lower end is noticeably truncate, there seems to be a small supplementary bone in the lip at the angle of the mouth and there are several teeth on the edge of the plate below the broad band. On the right side, the lower end of the wing is distinctly rounded, the patch of teeth does not extend so far down, and there are no teeth below it. The patch of teeth on the outside of the lateral wings of the premaxillary plate, mentioned above, does not occur in any others of the marine halfbeaks available in Field Museum. Its place is taken by a rather thick and fleshy lip that completely hides the teeth on the edge of the plate.

The premaxillary plate is scaled over practically its entire surface, only the edges and the extreme tip being naked.

The plate where the imbrication of the dorsal scales changes is directly over the gill opening.

Nasal barbel (see p. 44) very broadly spatulate, the expanded distal portion irregularly subtriangular, reflexed, nearly covering the nasal fossa but not rising appreciably above it. The form of

the barbel is very strikingly like that of certain woody fungi that have a short basal stem attached at one edge of a broadly expanded and rather thin distal portion.

The airbladder is cellular, with the separate cells about as long as the width of the entire structure.

Described from a single specimen collected by the Philip M. Chancellor-Field Museum Expedition to Aitutaki Island, Cook Archipelago, 1930, and now in Field Museum. *Chancellori*, for Mr. Philip M. Chancellor.

Arrhamphus Günther (1866).

Type *Arrhamphus sclerolepis* Günther 1866.

(1) Nasal barbel concealed in nasal fossa, form not described. (2) Anal fin not described, probably not modified in male. (3) Caudal fin forked, lower lobe much longer and wider than upper. (4) Beak very short, scarcely projecting beyond premaxillary plate. (5) Airbladder not described. (6) Ventrals nearer gill opening than hypural joint, small. (7) Body elongate, compressed, back not described, probably rounded. (8) Pectoral moderate, inserted high on body. (9) Dorsal fin inserted about over front of anal, about as long as anal, last rays not produced, distal margin concave. (10) Teeth in bands in both jaws, often tricuspid. (11) Premaxillary plate broader than long. (12) Scales large.

Euleptorhamphus Gill (1859).

Type *Euleptorhamphus brevoortii* Gill 1859.

(1) Nasal barbel concealed in nasal fossa, stump-shaped, tapering from a base that is nearly circular in cross section to a blunt tip that is about as wide and three times as long as the base. The nasal barbel is not recurved (described from No. 4146 F.M.N.H.). In most or all of the other genera of this group the tip of the nasal barbel is considerably flattened and the distal portion is recurved so as to lie over the top of the nasal fossa. (2) Anal fin not modified in the male. (3) Caudal deeply forked, the lower lobe much wider and longer than the upper. (4) Beak very long, much longer than rest of head. (5) Airbladder simple (Cuvier and Valenciennes, 1846, "*Hemirhamphus macrorhynchus*"). (6) Ventrals inserted much nearer to hypural joint than to gill opening, the fins small, the inner ray somewhat produced. (7) Body very long and compressed, band-like, the back thin and subcarinate. (8) Pectoral fins very long, inserted high on the body, very similar in structure to the pectorals

of Exocoetidae. (9) Dorsal fin inserted slightly in advance of anal, slightly longer than anal, last ray not produced, distal margin more or less convex. (10) Teeth in few series in each jaw, subconical above and tricuspid below. In a specimen, No. 4146 F.M.N.H., collected in the Hawaiian Islands, the teeth are strongly tricuspid in both jaws. The bands of teeth on the sides of the premaxillary plate do not quite meet in front, leaving a small interspace that is occupied by a triangular patch of teeth in other genera, but is toothless, at least in this specimen. The teeth on the lateral wings of the premaxillary plate do not extend on the outer surface of the plate but are seen on its forward edge down almost to the level of the top of the mandible when the mouth is fully opened. It is not possible to determine whether the teeth on the edge of the wings are concealed by fleshy lips as in *Hemirhamphus* and *Hyporhamphus*. In the lower jaw the teeth are on the rim of the mouth as in most other genera of the family. (11) Premaxillary plate about as long as broad (about two-thirds as long as broad, when measured across the wings, in specimen No. 4146 F.M.N.H.). (12) Scales moderate.

Farhians Whitley (1930).

Type *Hemirhamphus commersonii* Cuvier 1817, which is a redescription and renaming of *Esox far* Forskål 1775.

(1) Nasal barbel concealed in nasal fossa. In three specimens in Field Museum the nasal barbel is leaf-shaped, with a thick base and a reflexed, subtriangular distal portion that covers less than half of the nasal fossa. (2) Anal fin not modified in males. (3) Caudal deeply forked, the lower lobe much longer and wider than the upper. (4) Beak longer than rest of head. (5) Airbladder cellular. (6) Ventrals inserted nearer to hypural joint than to gill opening. (7) Body much deeper than wide, back rather broad, rounded. (8) Pectoral moderate, inserted high on side. (9) Dorsal fin inserted in advance of anal and longer than anal, distal margin concave, last ray slightly produced. (10) Teeth tricuspid, in bands on the jaws, none on the beak. (11) Premaxillary plate broader than long. In two specimens in Field Museum the premaxillary plate, as measured across the lateral wings is almost exactly twice as broad as long. In a very large specimen, 300 mm. in standard length, the width, measured in the same way, is about two and one-half times the length. (12) Scales large.

In speaking of the specific name of the genotype, Whitley (1930) says: "This species is generally known as *Hemirhamphus far* (Forskål), but the name *far* was only used in a vernacular sense,

until 1837, when Rüppell latinized it, but *H. commersonii* Cuvier has priority." With this view I am unable to agree. Forskål was not consistent in the form in which he listed the specific names he published. However, he seems to have had a certain general scheme that was followed with considerable regularity. Generic names were printed in large capitals, specific names were in small capitals, variety names had the initial letter a large capital, followed by small capitals. The generic name might or might not be repeated before the variety name. For example, his No. 42 is *Perca summana*, with varieties *fusco-guttata* and *areolata*. Of these two, *fusco-guttata* is treated in exactly the same manner as *far* in *Esox* (No. 98), while *areolata*, which follows it, is treated in the same manner as *belone*, under *Esox*. On page XI, in the list of "Pisces descripti," we find *Perca* with species *h*, *summana*, variety β , *fusco-guttata*, and variety δ , *areolata*. On page XIII of the same list we find *Esox* with species *marginatus*, variety β , *far*, and variety γ , *belone*. It seems clear that he considered *far* and *belone* varieties of *Esox marginatus*, just as he considered *fusco-guttata* and *areolata* varieties of *Perca summana*. I cannot see any reason for considering that *far* was used in a vernacular sense by Forskål. If it was so used, then *fusco-guttata*, under No. 42 of the fishes, was also used as a vernacular name.

Ardeapiscis Whitley (1931).

Type *Hemirhamphus welsbyi* Ogilby 1908.

(1) Nasal barbel concealed in the nasal fossa. (2) Anal fin not modified in the male (?). (3) Caudal fin very deeply forked, the lower lobe not described, probably larger than upper. (4) Beak a little longer than rest of head. (5) Airbladder not described. (6) Ventral insertion much nearer hypural joint than gill opening, the fin nearly as long as the pectoral. (7) Body elongate, compressed, back not described, probably rounded. (8) Pectoral moderate, probably inserted high on body. (9) Dorsal fin inserted in front of anal, the dorsal base longer than anal base, last ray produced, distal margin not described. (10) Teeth not on beak, form not described. (11) Premaxillary plate wider than long. (12) Scales large.

Hemirhamphus Cuvier (1817).

Type *Esox brasiliensis* Linnaeus 1758.

(1) Nasal barbel concealed in nasal fossa, the reflexed tip of expanded distal portion covering a portion of nasal fossa. (2) Anal fin not modified in the male, more or less falcate. (3) Caudal

fin deeply forked, the lower lobe wider and longer than the upper. (4) Beak usually not shorter than rest of head. (5) Airbladder cellular. (6) Ventral insertion nearer to hypural joint than to gill opening. (7) Body rather robust, deeper than wide, sides nearly vertical and parallel, back rounded, more or less. (8) Pectorals moderate, inserted high on side. (9) Dorsal fin inserted about over front of anal, the bases of the two about equal in length, the last ray somewhat produced, distal margin concave, more or less falcate. (10) Teeth simple, in bands on premaxillary plate and on the rim of mouth on lower jaw, none on beak. (11) Premaxillary plate about as long as broad. (12) Scales moderate.

It is likely that valid specific differences may be found in the form of the nasal fossa and the nasal barbel in this genus as well as in *Hyporhamphus*. In some forms examined in this connection the nasal fossa is hardly deeper or more pronounced than it is in *Zenarchopterus*. In that case, the barbel seems to be usually quite small. In other forms the nasal fossa may be very deep and continued back under the face bones to a considerable distance. In such cases the nasal barbel seems to be larger, with its expanded tip more definitely reflexed and roofing over the rear portion of the fossa. It seems evident that the reflexed portion of the barbel can be straightened up so that it stands well above the top of the head.

Rhynchorhamphus Fowler (1928).

Type *Hemirhamphus georgii* Cuvier and Valenciennes 1846.

(1) Nasal barbel concealed in nasal fossa. (2) Anal fin not modified in the male. (3) Caudal not deeply forked, lower lobe somewhat longer than upper. (4) Beak very long, much longer than rest of head. (5) Airbladder not described. (6) Ventral fins inserted nearer to hypural joint than to gill opening, about half as long as pectorals. (7) Body long, slender, somewhat compressed, back not described, probably rounded and fairly broad. (8) Pectoral moderate, inserted high on side. (9) Dorsal origin slightly in advance of that of anal, last ray not produced, distal margin convex anteriorly, straight posteriorly. (10) Teeth simple, in bands in jaws, none on beak. (11) Premaxillary plate longer than broad. (12) Scales large.

Described as a subgenus of *Hemirhamphus* and apparently considered of equal rank with the subgenera *Hyporhamphus* and *Hemirhamphus*, although nearer to the latter. Fowler based the separation of this form from the subgenus *Hemirhamphus* on the great length of the beak and of the premaxillary plate. It seems

that the form of the dorsal and caudal fins should also be considered generic characters in this case.

Hyporhamphus Gill (1859).

Type *Hyporhamphus tricuspidatus* Gill 1859.

(1) Nasal barbel concealed in nasal fossa (see p. 57). (2) Anal fin not modified in the male. (3) Caudal forked, the lower lobe longer than the upper. (4) Beak usually not longer than the rest of the head. (5) Airbladder simple. (6) Ventrals inserted about midway between gill opening and base of caudal, small. (7) Body elongate, compressed, sides not notably flattened, back fairly broad, rounded. (8) Pectorals moderate, inserted high on side. (9) Dorsal fin inserted about over anal and not differing greatly from it in length, last ray not produced, the distal margin concave. (10) Teeth tricuspid, in bands, none on beak. (11) Premaxillary plate not notably elongate, varying from a little longer than broad to a little broader than long. (12) Scales moderate to large.

Eulepidorhamphus Fowler (1919).

Type *Hemirhamphus sajori* Temminck and Schlegel 1846.

(1) Nasal barbel concealed in nasal fossa. (2) Anal fin probably not modified in male. (3) Caudal fin little forked, lower lobe little, if any, longer or wider than upper. (4) Beak shorter than rest of head. (5) Airbladder not described. (6) Ventral fins about midway between gill opening and hypural joint. (7) Body elongate, compressed, sides probably flattened, back probably rounded. (8) Pectoral rather small, inserted high on side. (9) Dorsal fin inserted directly over anal, about as long as anal, last ray not produced, distal margin straight. (10) Teeth in jaws small and tricuspid, in villiform bands, none on beak. (11) Premaxillary plate not described. (12) Scales very small.

Described by Fowler as a subgenus of *Hyporhamphus*, based on the small scales. Jordan and Hubbs (1925) redescribed *Hyporhamphus kurumeus* Jordan and Starks (1903), giving the number of scales as about 90 instead of 70 as in the original description. This brings the species very close to *Eulepidorhamphus*, as is also indicated by the original figure of the species. The tail of *kurumeus* is indicated as being somewhat more deeply forked than that of *sajori* but with the lobes approximately equal, the lower being one-third the diameter of the eye longer than the upper. A more complete study might well indicate that *sajori* and *kurumeus* are

congeneric and that they form as well differentiated a group as is found in *Hemirhamphus* or *Hyporhamphus*. The outline of generic characters above is taken from the excellent figure by Kumatarô Itô and the accompanying text (1931). Some of the species included by Whitley (1931) in his proposed genus *Reporhamphus* seem, except for the larger scales, quite close to *Eulepidorhamphus*.

Reporhamphus Whitley (1931).

Type *Hemirhamphus australis* Steindachner 1866.

(1) Nasal barbel concealed in nasal fossa. (2) Anal fin not modified in male. (3) Caudal fin moderately forked in *R. australis*, little forked in the other three; the lower lobe distinctly larger in *R. australis*, the lobes nearly equal in the other three. (4) Beak about as long as rest of head. (5) Airbladder simple in *R. melanochir* (Cuvier and Valenciennes 1846), not described in the other three. (6) Ventral fins nearer hypural joint than gill opening in *R. australis* and *R. melanochir*, nearer gill opening than hypural joint in *R. ardelio* Whitley 1931 and *R. regularis* Günther 1866. (7) Moderately elongate, compressed, very flat-sided, almost rectangular in cross section. (8) Pectoral fin moderate, inserted high on side. (9) Dorsal fin inserted about over anal and about the same length; last ray not produced; distal margin deeply concave, falcate in *R. australis*, moderately concave, not falcate in *R. ardelio*, nearly straight in *R. melanochir*, not described in *R. regularis*. (10) Teeth tricuspid in *R. australis* and *R. melanochir*, not described in the other two. (11) Premaxillary plate wider than long. (12) Scales moderate.

It is difficult, from the literature and without the possibility of examining specimens, to determine the basis on which this genus is founded (see p. 48). Apparently the author started with the premise that tropical Atlantic and southern Pacific halfbeaks cannot be congeneric. The genotype seems to be separated from the other three included species by the deeply forked tail. There are no characters given in the published descriptions that will separate it clearly from *Hyporhamphus* Gill or *Hemirhamphus* Cuvier and Valenciennes. The other three species have the tail only slightly forked, with the lobes approximately equal. In this character they do not seem to be different from *Eulepidorhamphus* Fowler, which has, however, very much smaller scales. There is room for a difference of opinion as to whether Whitley's (1931, p. 314, line 6) statement is a "definite bibliographic reference to a summary of characters" or whether McCulloch's (1922, p. 40) key is a "summary

of characters . . . which differentiate or distinguish the genus . . . from other genera" in a sense to satisfy the requirements of Article 25, section c, parts 1 and 2 of the International Rules of Zoological Nomenclature as amended September 4-9, 1927.

Oxyporhamphus Gill (1863).

Hemiexocoetus Fowler (1901).

These two generic names are placed in the family Hemirhamphidae in Jordan's (1923) list, but it is extremely probable that both belong in the Exocoetidae (see p. 43). Therefore, a summary of the characters assigned to them would add nothing to our understanding of the present family.

The characters mentioned in the above summaries are, of course, not all that might be used in separating groups of halfbeaks. They were selected because they happen to have been used in most of the papers dealing with this group, or in the most important papers. The revision of the genus *Zenarchopterus* by Mohr (1926) is the best by far that has come to my attention and it is to be hoped that the entire family may be worked over as carefully in the near future.

Among other characters that should be mentioned in generic and specific diagnoses in this group are the number, form, and arrangement of the gill rakers and the form of the interorbital area and its relation to the position of the eye. The arrangement of the lateral bands of teeth on the premaxillary plate seems to offer possibilities in generic description. In some cases these bands are broad at the forward end, with a triangular patch of different teeth between them. In other cases this patch of teeth is absent. Sometimes these bands are pointed at front, with a toothless area between them. This character seems to offer much promise as an aid in generic diagnosis in the family Hemirhamphidae.

Somewhere on the back, in all Hemirhamphidae, there is a change in the imbrication of the scales. One scale has a free edge all around. The scales in front of it have the free edge forward instead of to the rear, while those around it are variously arranged to make up for the change. The position of this scale and the arrangement of the ones around it may be of considerable value in the separation of various groups.

Hyporhamphus hildebrandi Jordan and Evermann (1927).

In "The Marine Fishes of Panama," page 239, Meek and Hildebrand (1923), under the name *Hyporhamphus roberti* (Cuvier and

Valenciennes) (1846), described a halfbeak that Jordan and Evermann (1927, p. 503) on the basis of the previous description consider a new species, giving it the name *Hyporhamphus hildebrandi*, "Type No. ?, Field Museum Nat. Hist., a specimen collected by Meek and Hildebrand at Toro Point, Fox Bay, Colon." All the specimens (seven) of this species in Field Museum are labeled "Fox Bay, Colon, Panama," without any indication as to the precise location in the bay. Jordan and Evermann plainly state, "This species is based upon specimens obtained by Meek and Hildebrand at Toro Point, Fox Bay, Colon, and identified by them with *Hemirhamphus roberti* Cuv. & Val., 1846," It seems necessary, therefore, to consider the entire lot in Field Museum, or the entire lot studied by Meek and Hildebrand, as cotypes, with no type specimen designated. I, therefore, designate as lectotype the largest specimen of this species in Field Museum and submit the following description of this specimen:

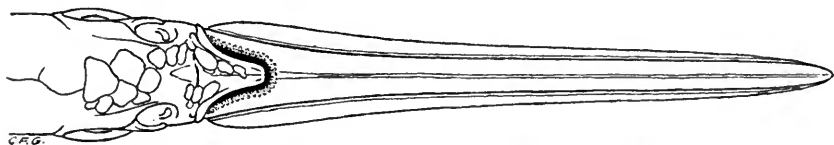


FIG. 2. *Hyporhamphus hildebrandi*. Dorsal view of head.

Type from Fox Bay, Colon, Panama. No. 8260 Field Museum of Natural History. Length, total 240 mm. (from tip of premaxillary plate to hypural joint, 105 mm.). Collected March 25, 1911, by S. E. Meek and S. F. Hildebrand.

D. 15; A. 17; P. 10; V. 6; scales in lateral series about 70 (60 to 70 according to method of counting), rather deciduous and about half of those in lateral series lost. Gill rakers about 30 on the lower arm and about 5 on the upper arm of gill arch. There is a fairly clear division between the upper and lower arms of the gill arch. Branchiostegals 12. Beak .33 (.22 of total length), 1.65 times rest of head. Head from tip of premaxillary plate .22. Entire head .53 (.36 of total length). Eye .06 (3.5 in head). Length of premaxillary plate .048 (4.6 in head), its width .057 (3.9 in head). Interorbital width .067 (3.3 in head), flat, sharply curved down to the top of the orbit on each side, the general level notably above the orbits. Depth .10 (2.2 in head). Width of body .076 (2.9 in head, 1.3 in depth). Length of pectoral .11 (2 in head). Length of ventral .086 (2.5 in head, 1.3 in pectoral). Distance from origin of ventral to hypural joint .38, to gill opening .40. Dorsal origin directly over that of anal.

Anal slightly and dorsal apparently not scaled at base. Distal margins of both fins concave forward, about straight for more than half the length at rear, the front rays somewhat produced, not falcate, the last rays not or slightly produced. Caudal moderately forked, the lower lobe longer and wider than the upper. The back broadly rounded. The lateral line does not, perhaps, form quite so well defined a keel as in some other species but does rather sharply indicate the edges of the narrow, flat belly. The sides below the lateral stripe are rather flat and converge towards the belly. The premaxillary plate, measured from the top of the head, with the mouth open, is considerably shorter than the width across the wings. The tip is slightly truncate. The teeth are in a broad band on each side of the premaxillary plate. Those on the wings do not seem to extend downward quite so far as in *Odontorhamphus* and are concealed by fleshy lips. So far as can be observed without careful dissection, the lower end of the band is above the level of the top of the mandible. The lateral bands of teeth on the premaxillary plate are separated by a rather broad space at the front, with a very small, triangular patch uniting them at the extreme front. This patch does not extend as far to the sides as the width of the truncated portion of the front of the plate. The teeth in both jaws are sharply tricuspid. The teeth of the lower jaw are in a moderately broad band which is mainly on top of the mandible around the mouth depression. The band extends down into the mouth on the sides of the depression but is sufficiently well developed on top of the mandible to be readily seen from the side. At the rear, the band of teeth tapers to a sharp point that is well behind the corner of the mouth. The premaxillary plate is scaled nearly to its tip, only the edges of the upper surface all around being naked.

The nasal barbel is somewhat flattened, between spatulate and club-shaped. The membrane on which it stands is not sunk so deeply into the nasal fossa as in most species of this group of Hemirhamphidae. It seems likely that the barbel stands well above the surface of the head in life.

The silvery color has been entirely destroyed in the preservative, leaving only a black band along the side. This band is very narrow forward but is about as wide as the pupil between the dorsal and anal fins. It is plainly visible from the upper angle of the gill opening to the base of the caudal, where it widens slightly to form a roundish spot a little larger than the pupil.

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